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Notices
of the American Mathematical Society

1987 Annual AMS-MAA Survey

First Report

This article is a reprint of the material that appeared in the November 1987 issue of *Notices* with corrections to the section "Salary Survey for New Recipients of Doctorates", pp. 1079–1080.

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First Report

The following pages contain a first report on the 1987 AMS-MAA Survey. Included in this report are salary and other data on faculty members in four-year colleges and universities, a report on the 1987 survey of new doctorates, a report on salaries of new doctorates, and a list of names and thesis titles for members of the 1986-1987 Ph.D. class.

The Annual AMS-MAA Survey is conducted in two parts. Questionnaires were distributed in May to departments in the mathematical sciences in colleges and universities in the United States and Canada, and later to the recipients of doctoral degrees granted by these departments between July 1986 and June 1987, inclusive. This report is based on the information collected from these questionnaires. A second round of questionnaires was distributed in September; these are concerned with data on fall enrollments, class size, teaching loads, and faculty mobility. These data will be reported in the February 1988 issue of *Notices*.

This Survey is the thirty-first in an annual series begun in 1957 by the Society's Committee on the Economic Status of Teachers. The present Survey, the first to be jointly sponsored by the American Mathematical Society and the Mathematical Association of America, is under the direction of the AMS-MAA Committee on Employment and Educational Policy (CEEP). Members of the committee are Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Philip C. Curtis, Jr., David J. Lutzer, Donald C. Rung, and Audrey A. Terras. The questionnaires were devised by CEEP's Data Subcommittee consisting of Lida K. Barrett, Edward A. Connors (chair), Lincoln K. Durst, James Hurley, Charlotte Lin, James W. Maxwell, Donald E. McClure, and Donald C. Rung.

Faculty Salaries, Tenure, Women

The questionnaires sent to departments in the mathematical sciences asked for information on salaries and tenure. Departments submitted a minimum, median, and maximum salary figure for each of four academic ranks, for staff members both with and without doctorates. Annual salaries of full-time faculty members for the academic year of 9 or 10 months were sought. The 1987 questionnaire requested information for both the years 1986-1987 and 1987-1988. The sample in this survey is thus the same for both years and is different from the sample used in the Thirtieth AMS Survey in 1986. In the salary tables on the following pages the numbers in parentheses give the range of the middle fifty percent of salaries reported. The figures outside the parentheses represent the minimum and maximum salary listed by any reporting institution. In some categories relatively few departments reported and, because significant figures were not available, salaries are not listed.

The information reported this year on the number of faculty members is based on returns from 699 departments in the mathematical sciences, 59 of which did not contain usable salary information.

For these reports, the departments are divided into groups according to the highest degree offered in the mathematical sciences. The doctorate-granting departments are in six groups as described in the box.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0 – 5.0 range.

Group II is composed of 43 departments with scores in the 2.0 – 2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

[1]These findings were published in *An Assessment of Research Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257 – 267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392 – 393.

Table 1: Total Faculty Reported for Four-Year Colleges and Universities

	1986–1987				1987–1988			
	Faculty		Women		Faculty		Women	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
WITHOUT DOCTORATE								
Instructor/Lecturer	905	41	514	22	840	42	492	22
Assistant Professor	637	350	209	95	610	316	202	87
Associate Professor	422	363	59	48	369	331	53	42
Professor	149	144	21	21	163	192	23	23
Total	2113	898	803	186	1982	881	770	174
WITH DOCTORATE								
Instructor/Lecturer	282	38	67	8	215	15	49	5
Assistant Professor	2099	240	369	63	2036	198	349	33
Associate Professor	2636	2258	266	215	2596	2220	284	233
Professor	4671	4585	242	226	4637	4540	228	211
Total	9688	7121	944	512	9484	6973	910	482

TABLE 2: Percent of Doctorate Faculty with Tenure

	Fall 1986	Fall 1987
Groups I, II, III	75.7%	76.4%
Groups IV, V	71.0%	70.0%
Group VI	89.6%	88.1%
Masters and Bachelors	69.7%	69.3%

TABLE 3: Response Rates

U.S. Departments

Group	I	II	III	IV	V	M	B
% Response	82	74	77	65	39	54	38

Canadian Departments

Group	VI
% Response	54

Response Rates. Response rates among the various classes of departments vary widely, thus making it difficult to draw firm conclusions about the sizes of the faculty groups studied. Because the questionnaires request data for two years in a row, however, it is possible to estimate relative changes from one year to the next with somewhat more confidence. This year's response rates are given in Table 3. As in past years, the greatest rates of response are in Groups I, II, and III, which have a combined response rate of 78%.

SIZE OF FACULTY

	1986–1987 FACULTY Total	1986–1987 FACULTY With Tenure	1986–1987 WOMEN Total	1986–1987 WOMEN With Tenure	1987–1988 FACULTY Total	1987–1988 FACULTY With Tenure	1987–1988 WOMEN Total	1987–1988 WOMEN With Tenure
DOCTORATE GRANTING DEPARTMENTS, Group I					(32 of 39 reporting)			
WITHOUT DOCTORATE								
Instructor/Lecturer	16	2	7	1	17	2	7	1
Assistant Professor	2	2	1	1	0	0	0	0
Associate Professor	2	2	0	0	1	0	0	0
Professor	1	1	0	0	1	0	0	0
	21	7	8	2	19	2	7	1
WITH DOCTORATE								
Instructor/Lecturer	109	2	14	0	104	2	15	0
Assistant Professor	236	4	23	0	250	4	20	0
Associate Professor	239	228	14	14	234	224	16	16
Professor	970	970	25	25	983	982	26	26
	1554	1204	76	39	1571	1212	77	42
DOCTORATE GRANTING DEPARTMENTS, Group II					(32 of 43 reporting)			
WITHOUT DOCTORATE								
Instructor/Lecturer	66	3	45	1	64	3	44	1
Assistant Professor	5	4	1	0	5	4	1	0
Associate Professor	4	3	1	0	3	2	1	0
Professor	2	2	0	0	2	2	0	0
	77	12	47	1	74	11	46	1
WITH DOCTORATE								
Instructor/Lecturer	33	2	6	0	21	2	3	0
Assistant Professor	229	29	31	1	211	27	28	1
Associate Professor	332	309	20	18	304	289	18	18
Professor	615	614	23	23	577	575	19	19
	1209	954	80	42	1113	893	68	38
DOCTORATE GRANTING DEPARTMENTS, Group III					(61 of 79 reporting)			
WITHOUT DOCTORATE								
Instructor/Lecturer	113	1	70	1	112	0	68	0
Assistant Professor	43	32	13	9	38	28	13	8
Associate Professor	22	22	2	2	20	20	2	2
Professor	9	8	0	0	9	9	0	0
	187	63	85	12	179	57	83	10
WITH DOCTORATE								
Instructor/Lecturer	29	0	10	0	20	0	6	0
Assistant Professor	384	35	60	4	374	32	51	4
Associate Professor	476	423	29	28	486	435	30	28
Professor	669	655	23	22	702	687	26	26
	1558	1113	122	54	1582	1154	113	58

SALARIES

(in hundreds of dollars)

	1986–1987 Minimum	1986–1987 Median	1986–1987 Maximum	1987–1988 Minimum	1987–1988 Median	1987–1988 Maximum
DOCTORATE GRANTING DEPARTMENTS, Group I						
WITHOUT DOCTORATE						
Instructor/Lecturer	226(238-284)	(241-280)	(244-285)512	237(263-299)	(269-304)	(277-315)527
Assistant Professor	229(262-294)	(280-318)	(315-352)421	240(273-310)	(294-325)	(334-377)434
Associate Professor	268(321-385)	(364-418)	(402-470)540	279(318-389)	(369-439)	(415-494)740
Professor	302(346-424)	(490-578)	(688-853)952	310(354-445)	(517-626)	(722-900)1100
DOCTORATE GRANTING DEPARTMENTS, Group II						
WITHOUT DOCTORATE						
Instructor/Lecturer	150(155-199)	(175-233)	(185-255)356	156(158-207)	(180-239)	(200-258)371
Assistant Professor	—	—	—	—	—	—
Associate Professor	—	—	—	—	—	—
Professor	—	—	—	—	—	—
WITH DOCTORATE						
Instructor/Lecturer	147(180-224)	(186-234)	(189-234)376	156(191-250)	(208-247)	(208-247)381
Assistant Professor	226(250-296)	(273-314)	(299-355)427	250(260-309)	(280-320)	(308-354)429
Associate Professor	257(284-334)	(317-385)	(368-442)527	269(285-344)	(327-394)	(375-469)553
Professor	311(340-406)	(432-527)	(597-760)848	314(352-430)	(452-540)	(630-809)900
DOCTORATE GRANTING DEPARTMENTS, Group III						
WITHOUT DOCTORATE						
Instructor/Lecturer	120(158-201)	(170-205)	(180-221)340	120(163-198)	(167-200)	(190-232)352
Assistant Professor	201(225-276)	(244-292)	(244-307)427	209(224-261)	(251-285)	(263-312)427
Associate Professor	277(288-343)	(299-361)	(303-391)418	277(284-362)	(297-402)	(305-426)430
Professor	—	—	—	—	—	—
WITH DOCTORATE						
Instructor/Lecturer	163(178-236)	(188-242)	(196-248)306	173(189-289)	(192-289)	(200-292)315
Assistant Professor	200(240-267)	(260-290)	(282-330)394	208(250-284)	(273-310)	(300-351)412
Associate Professor	187(270-330)	(310-366)	(342-415)533	190(279-334)	(320-380)	(350-440)533
Professor	296(336-401)	(404-477)	(500-646)898	234(334-421)	(407-506)	(515-691)950

DOCTORATE GRANTING DEPARTMENTS, Group IV					(44 of 68 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	11	2	5	1	11	2	5	1						
Assistant Professor	3	3	0	0	3	3	0	0						
Associate Professor	0	0	0	0	0	0	0	0						
Professor	2	2	0	0	2	2	0	0						
	16	7	5	1	16	7	5	1						
WITH DOCTORATE														
Instructor/Lecturer	15	2	8	2	13	2	8	2	—	—	—	—	—	—
Assistant Professor	148	1	25	0	152	1	27	0	245(267-300)	(285-319)	(302-352)422	268(285-319)	(303-344)	(309-367)442
Associate Professor	142	114	16	10	146	109	14	10	270(316-372)	(344-393)	(378-444)568	280(327-390)	(358-410)	(369-470)571
Professor	367	356	16	14	367	356	15	12	324(390-474)	(475-588)	(566-773)948	341(394-483)	(481-605)	(597-800)1022
	672	473	65	26	678	468	64	24						
DOCTORATE GRANTING DEPARTMENTS, Group V					(12 of 31 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	0	0	0	0	0	0	0	0						
Assistant Professor	1	1	0	0	1	1	0	0						
Associate Professor	0	0	0	0	0	0	0	0						
Professor	1	1	0	0	1	1	0	0						
	2	2	0	0	2	2	0	0						
WITH DOCTORATE														
Instructor/Lecturer	3	0	1	0	3	0	1	0	—	—	—	—	—	—
Assistant Professor	28	2	1	0	27	0	2	0	272(285-333)	(300-359)	(330-380)380	290(323-373)	(318-377)	(377-395)410
Associate Professor	22	16	0	0	22	18	1	0	302(325-390)	(381-416)	(385-466)468	302(340-416)	(372-436)	(402-480)487
Professor	86	85	3	3	87	86	4	3	412(423-530)	(513-613)	(695-780)850	417(439-555)	(532-622)	(731-850)880
	139	103	5	3	139	104	8	3						
DOCTORATE GRANTING DEPARTMENTS, Group VI (Canadian Departments)					(15 of 28 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	15	2	6	2	11	2	5	2						
Assistant Professor	18	13	4	4	18	11	4	4						
Associate Professor	9	9	2	2	11	11	2	2						
Professor	7	7	0	0	7	7	0	0						
	49	31	12	8	47	31	11	8						
WITH DOCTORATE														
Instructor/Lecturer	4	0	2	0	2	0	1	0	—	—	—	—	—	—
Assistant Professor	53	14	12	3	59	11	11	2	237(260-295)	(280-360)	(300-406)487	230(257-292)	(274-316)	(308-372)445
Associate Professor	165	157	10	8	159	151	8	8	310(316-390)	(391-495)	(417-540)629	297(328-401)	(381-475)	(414-538)677
Professor	268	268	4	4	277	276	6	5	380(402-472)	(461-617)	(500-737)871	380(403-469)	(422-559)	(487-790)926
	490	439	28	15	497	438	26	15						

SIZE OF FACULTY

	1986–1987 FACULTY		1986–1987 WOMEN		1987–1988 FACULTY		1987–1988 WOMEN	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
MASTER DEGREE GRANTING DEPARTMENTS				(142 of 263 reporting)				
WITHOUT DOCTORATE								
Instructor/Lecturer	388	23	223	12	357	25	215	13
Assistant Professor	217	158	69	43	183	136	62	37
Associate Professor	150	145	30	25	146	136	27	21
Professor	58	58	12	12	75	74	14	14
	813	384	334	92	761	371	318	85
WITH DOCTORATE								
Instructor/Lecturer	76	30	20	6	39	7	11	3
Assistant Professor	544	94	100	46	524	75	101	15
Associate Professor	718	608	93	79	706	586	106	85
Professor	1041	1018	84	77	985	957	75	69
	2379	1750	297	208	2254	1625	293	172
BACHELOR DEGREE GRANTING DEPARTMENTS				(361 of 951 reporting)				
WITHOUT DOCTORATE								
Instructor/Lecturer	296	8	158	4	268	8	148	4
Assistant Professor	348	137	121	38	362	133	122	38
Associate Professor	235	182	24	19	188	162	21	17
Professor	69	65	9	9	66	97	9	9
	948	392	312	70	884	400	300	68
WITH DOCTORATE								
Instructor/Lecturer	13	2	6	0	13	2	4	0
Assistant Professor	477	61	117	9	439	48	109	11
Associate Professor	542	403	84	58	539	408	91	68
Professor	655	619	64	58	659	621	57	51
	1687	1085	271	125	1650	1079	261	130

SALARIES

(in hundreds of dollars)

	1986–1987			1987–1988		
	Minimum	Median	Maximum	Minimum	Median	Maximum
WITHOUT DOCTORATE						
Instructor/Lecturer	130(171-210)	(184-224)	(200-250)530	123(184-225)	(195-235)	(212-264)554
Assistant Professor	144(227-277)	(248-294)	(258-320)412	144(239-288)	(250-306)	(271-334)401
Associate Professor	177(269-349)	(285-352)	(312-380)447	177(286-372)	(293-376)	(312-390)472
Professor	200(336-414)	(346-454)	(366-464)495	200(322-411)	(367-473)	(379-495)512
WITH DOCTORATE						
Instructor/Lecturer	140(173-250)	(211-277)	(221-286)392	156(162-296)	(210-303)	(208-335)411
Assistant Professor	169(240-270)	(256-288)	(280-329)416	169(252-280)	(268-299)	(290-330)441
Associate Professor	196(277-325)	(296-355)	(325-401)484	196(290-336)	(310-366)	(348-415)506
Professor	231(327-394)	(363-445)	(401-504)682	231(350-411)	(383-468)	(422-524)840
WITHOUT DOCTORATE						
Instructor/Lecturer	120(182-216)	(184-224)	(194-240)353	120(188-220)	(193-230)	(230-245)383
Assistant Professor	150(216-264)	(219-279)	(235-307)400	150(220-270)	(226-281)	(244-309)399
Associate Professor	170(265-338)	(259-341)	(270-366)444	185(256-343)	(271-352)	(273-369)464
Professor	204(321-390)	(320-405)	(338-436)700	234(325-421)	(319-394)	(351-451)730
WITH DOCTORATE						
Instructor/Lecturer	180(203-231)	(205-274)	(215-292)353	189(205-245)	(210-285)	(225-306)353
Assistant Professor	135(235-261)	(242-274)	(250-300)465	202(250-275)	(254-290)	(268-318)493
Associate Professor	170(267-317)	(277-331)	(292-363)484	184(281-330)	(289-348)	(307-388)505
Professor	180(315-396)	(329-418)	(354-468)720	217(322-410)	(341-436)	(366-481)765

Salary Survey for New Recipients of Doctorates

The figures for 1987 in this article were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1986-1987 academic year from universities in the United States and Canada.

Questionnaires requesting information on salaries and professional experience were distributed to 695 recipients of degrees using addresses provided by the departments which granted the degrees. Of these, 10 were returned by the postal service as undeliverable and could not be forwarded. There were 307 individuals who returned forms between late June and early September. The tables below are based on the responses from 284 of these individuals (232 men and 52 women). Data from 23 responses were not used in the compilation of the tables below; forms with insufficient data, or from individuals who had indicated they had part-time employment, were not yet employed, or were not seeking employment were considered unusable.

Readers should be warned that the data in this report are obtained from a self-selected sample and inferences from them may not be representative of the population. More comprehensive information on the number, the sex—minority group status—citizenship, and the employment status of the recipients of new doctorates granted last year in the mathematical sciences in the U.S. and Canada may be found in the following article of this report on the 1987 Survey.

Key to Tables. *Salaries* are listed in hundreds of dollars. *Years* listed refer to the academic year ending in the listed year. *M* and *F* are Male and Female respectively. *One year experience* means that the persons had experience limited to one year or less in the same position or a position similar to the one reported; some persons receiving a doctorate had been employed in their present position for several years. $(X + Y)$ means there are *X men and Y women* in the 1987 sample. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

Note that the column previously headed "1965 Salary Median in Current $" has been replaced by the column headed "Reported median in 86 $." The new column makes it possible to see when the year-to-year changes in the reported median represent real changes in the purchasing power of the median income. It also results in simplified graphical presentation of these data.

Graphs. The horizontal line represents the median salary for 1986 in hundreds of dollars. The points plotted are the relevant data for each year converted to 1986 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. Where available, first and third quartiles appear as boxes along the vertical lines. (Because the deflator is not yet available for this year, the 1987 figures do not appear on the graphs.)

Note that throughout the graphs, salaries have yet to return to their high point of 1970, although steady progress has been made since 1980. (For a more detailed analysis of academic salaries see Donald Rung's article, "A Fifteen Year Retrospective on Academic Salaries of U.S. Doctorate Holding Faculty," in the November 1985 issue of *Notices*, pp. 772-773.)

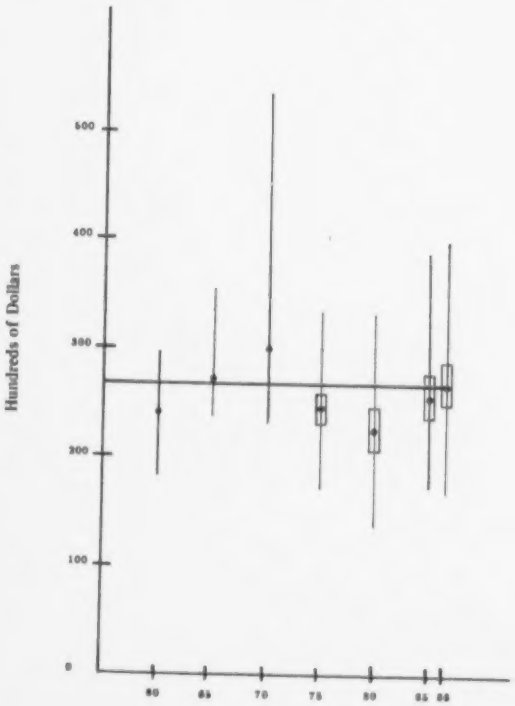
Nine-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1986 $
TEACHING OR TEACHING AND RESEARCH (138 + 29)						
1960	49		65		80	241
1965	70		80		105	271
1970	85		110		195	300
1975	90	120	128	135	173	247
1980	105	155	171	185	250	229
1982	160	190	206	229	370	236
1983	80	200	217	240	350	239
1984	140	215	230	255	380	244
1985	170	23	250	270	380	257
1986	170	250	269	290	400	269
1987	165	260	280	300	517	—
1984M	140	215	232	255	380	
1984F	161	215	228	251	325	
1985M	186	232	250	270	380	
1985F	170	215	242	270	366	
1986M	170	250	269	290	400	
1986F	230	250	268	294	270	
1987M	165	260	280	300	517	
1987F	230	251	280	325	420	
One Year Experience (121 + 25)						
1987M	165	260	280	300	430	
1987F	240	262	280	321	420	

Nine-Month Salaries

Year	Min	Median	Max	Reported Median in 1986 $
RESEARCH (5 + 0)				
1960	52	65	80	241
1965	71	81	90	274
1970	78	105	160	286
1975	100	—	110	—
1980	125	137	180	183
1982	180	190	235	218
1983	100	200	230	220
1984	205	205	205	218
1985	205	235	250	241
1986	215	245	280	245
1987	250	300	300	—
1984M	205	205	205	
1984F	—	—	—	
1985M	205	226	250	
1985F	—	—	—	
1986M	215	250	280	
1986F	240	240	240	
1987M	250	300	300	
1987F	—	—	—	
One Year Experience (5 + 0)				
1987M	250	300	300	
1987F	—	—	—	

Nine-Month Teaching



Graph omitted because sample size too small

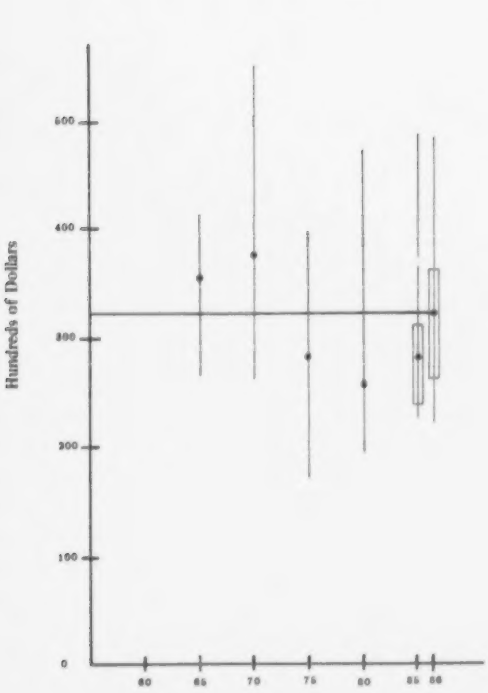
Twelve-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1986 $
TEACHING OR TEACHING AND RESEARCH (27 + 8)						
1960	..... NO DATA					
1965	78		104		121	352
1970	95		128		200	349
1975	87		145		204	280
1980	143		195		350	261
1982	100		250		500	286
1983	160		260		320	287
1984	134		260		450	276
1985	220	230	273	300	470	280
1986	220	265	320	360	480	320
1987	200	283	315	357	520	
1984M	134		260		450	
1984F	240		275		330	
1985M	230	235	240	300	470	
1985F	220	243	280	295	420	
1986M	220	270	321	360	480	
1986F	240	245	285	340	360	
1987M	200	270	300	358	520	
1987F	300	320	339	357	450	
One Year Experience (20 + 7)						
1987M	200	266	295	323	410	
1987F	300	320	327	352	360	

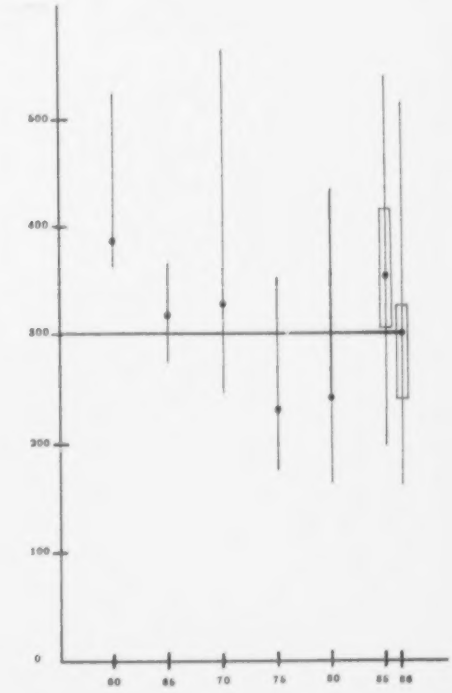
Twelve-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1986 $
RESEARCH (20 + 3)						
1960	97		105		140	389
1965	81		93		107	315
1970	90		120		205	327
1975	90		119		180	230
1980	120		180		321	241
1982	130		245		364	281
1983	155		262		450	289
1984	145		261		415	277
1985	190	295	342	400	520	351
1986	160	240	300	325	510	300
1987	200	260	287	337	430	
1984M	170		283		415	
1984F	145		200		253	
1985M	190	300	360	405	520	
1985F	279	290	300	312	323	
1986M	160	240	300	330	510	
1986F	240	240	270	300	300	
1987M	200	250	282	337	400	
1987F	300	308	316	373	430	
One Year Experience (18 + 1)						
1987M	200	250	278	320	400	
1987F	300	300	300	300	300	

Twelve-Month Teaching



Twelve-Month Research

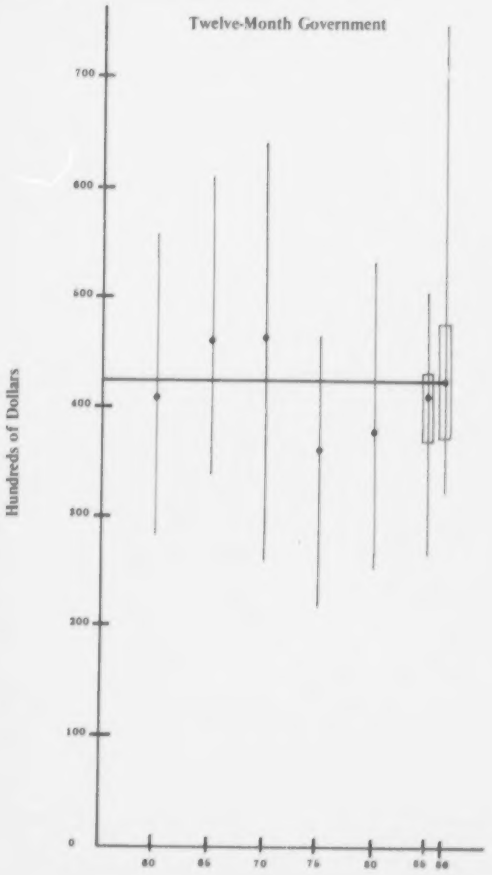


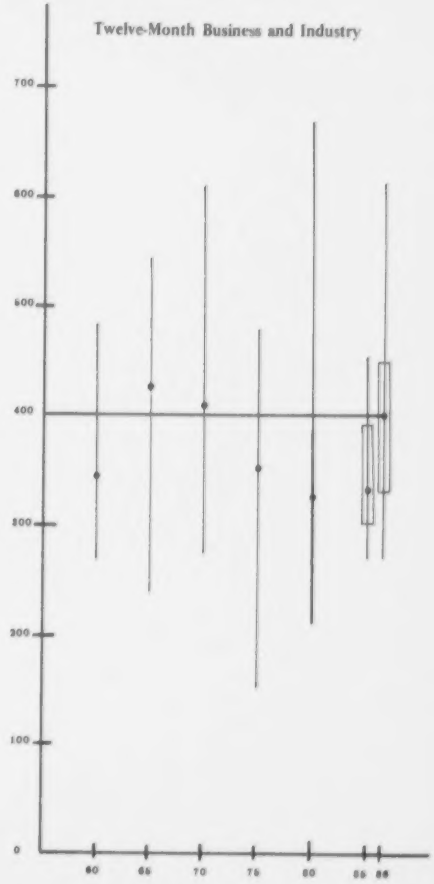
Twelve-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1986 $
GOVERNMENT (12 + 0)						
1960	72		93		130	345
1965	70		126		160	427
1970	100		150		223	409
1975	78		182		247	351
1980	156		244		501	326
1982	228		325		470	372
1983	160		322		422	355
1984	140		315		490	334
1985	263	294	325	381	440	334
1986	270	330	400	449	610	400
1987	200	290	360	465	500	
1984M	288		326		490	
1984F	140		202		263	
1985M	263	294	325	381	440	
1985F						
1986M	270	330	400	449	610	
1986F						
1987M	200	290	360	465	500	
1987F						
One Year Experience (7 + 0)						
1987M	200	270	326	405	500	
1987F						

Twelve-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1986 $
BUSINESS AND INDUSTRY (30 + 12)						
1960	78		110		150	408
1965	100		136		180	461
1970	96		170		235	464
1975	114		187		240	361
1980	190		284		400	379
1982	196		354		550	405
1983	276		375		580	413
1984	180		378		660	401
1985	260	360	400	420	493	411
1986	324	373	425	477	750	425
1987	290	400	451	500	1500	
1984M	180		383		660	
1984F	200		342		416	
1985M	260	360	400	425	493	
1985F	295	330	370	409	430	
1986M	324	390	453	492	750	
1986F	350	357	375	400	440	
1987M	290	400	465	517	1500	
1987F	300	394	424	466	502	
One Year Experience (17 + 7)						
1987M	290	390	410	470	536	
1987F	300	386	400	426	480	





Report on the 1987 Survey of New Doctorates

Edward A. Connors

This report presents a statistical profile of new doctorates in mathematical sciences awarded by universities in the United States and Canada during the period July 1, 1986, through June 30, 1987. It includes the employment status of recipients of 1986–1987 doctorates in the mathematical sciences (as of August 31, 1987) and an analysis of the data by sex, minority group, and citizenship. In addition, trends in the number of doctoral degrees are reported for each of Groups I through V. (See the first page of this Report of the 1987 Annual AMS-MAA Survey for a description of the classification system and *Notices*, June 1983, for a listing of the departments in Groups I and II.) Table 0 provides information on the response rates for this part of the Survey.

TABLE 0: Response Rates

Group I	39 of 39
Group II	40 of 43 including 1 with 0 degrees
Group III	70 of 79 including 25 with 0 degrees
Group IV	53 of 70 including 7 with 0 degrees
Group Va	13 of 19 including 1 with 0 degrees
Group Vb	17 of 38 including 6 with 0 degrees
Group VI	27 of 29 including 5 with 0 degrees

We continue the practice adopted in the 1983 Report and do not report doctorates granted by computer science departments (formerly included with the totals for Group V departments). The reporting rate of computer science doctorates was considered too small to merit inclusion. In the 1982 Survey, for example, 105 doctorates in computer science were reported whereas the actual number of degrees granted was more than twice that number. For 1982 the National Science Foundation reported 220 doctorates awarded in computer science (under the heading Mathematical Sciences) and 72 doctorates in Computer Engineering (*Science and Engineering Doctorates: 1960–82*, NSF 83-328, pages 19 and 17 respectively). In contrast, virtually all of the mathematical sciences doctorates are reported. Thus, any year to year comparisons that bridge the 1982 and 1983 Surveys should accommodate this modification.

Again this year we present in Table 1C the number of doctorates in the mathematical sciences awarded by departments and/or programs in Groups I, II, III, IV, Va, and VI for the years 1982-1983 to 1986-1987. All but the entry for 1986-1987 are the spring counts.

TABLE 1A: New Doctorates, Fall Counts

80-81	81-82	82-83	83-84	84-85	85-86	86-87
812	755	792	789	769	801	845

TABLE 1B: New Doctorates, Fall and Spring Counts

	80-81	81-82	82-83	83-84	84-85	85-86	86-87
Fall	904*	860*	792	789	769	801	845
Spring	927*	914*	840	827	807	827	**

TABLE 1C: New Doctorates Awarded by Groups I–Va, VI

82-83	83-84	84-85	85-86	86-87
767	735	755	743	780***

* Includes computer science.
** To appear in *Notices*, February 1988.
*** This is a fall count. The other entries in Table 1C are spring counts.

Table 1C will be updated to include a spring count of 1986-1987 in the February 1988 *Notices*.

Table 1C will be updated to include a spring count of 1986–1987 in the February 1988 Notices.

The number of new doctorates reported for 1986–1987 is 845 (fall 1987 count) compared to 801 for 1985–1986 (fall 1986 count). See Table 1A for comparable statistics for 1980–1981 through 1984–1985. These numbers are obtained from the Annual Survey Reports in the November *Notices*. In Table 1C we record a count of new doctorates in the mathematical sciences in the U.S. and Canada for the years 1982-1983 through 1986-1987, exclusive of Group Vb. The response rate for Group Vb is the lowest of all groups, and the responders include departments in engineering and management science.

As is customary, a second, updated report is planned for the February 1988 issue of *Notices*. Table 1B contrasts the number of new doctorates reported in the November Reports with the more complete totals reported in the following spring Reports for the years 1980–1981 to 1985–1986. The last column is the number reported in this Survey. Note that the table entries prior to 1982–1983 include the computer science departments and, thus, this table is comparable to Table 1B from last year's Report (*Notices*, November 1986, page 919).

The data for 1986–1987 show an increase of 5% in doctorates awarded compared to 1985–1986 and an increase of 8% over the five-year average from the years 1981–1982 through 1985–1986. These percentages are computed from the fall counts of the years cited. The second part of this report, to appear in February, will include a similar computation based on spring counts.

Of the 779 doctorates reported from U.S. universities (there were 66 doctorates from Canadian universities), the citizenship is reported as known for 739 recipients, with U.S. citizens accounting for 49% (362). The percentage of U.S. citizens

TABLE 2A: Employment Status of 1986–1987 New Doctorates in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS												Total
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other		
Group I	21	17	17	1	1	1			8		4		70
Group II	7	6	5		3	2	1	2	7		3		36
Group III	7	11	1	1	1	7	3	2	12	1			46
Group IV					3	21		1			1		26
Group V									8		2		10
Masters	12	13	10		3	10	1	2	11	1	1		64
Bachelors	15	10	8		3	11		3	11	2	3		66
Two-year College	3	1		1					1				6
Other Academic Departments	2	2		1	1	31	4	10	8		11		70
Research Institutes	3	3	4			3		3	5		2		23
Government	1					7	1		5		4		18
Business and Industry	6	6	1	4	7	28	1	10	13		16		92
Canada, Academic	4	6	2		1	8	1	1	3		6		32
Canada, Nonacademic						3			1				4
Foreign, Academic	22	29	14	3	4	23	2	9	27	1	8		142
Foreign, Nonacademic	3	4				5	1	2	1		3		19
Not seeking employment		2	2						1		1		6
Not yet employed	5	10	4	1		11	1	2	8		2		44
Unknown	7	13	11	4		11	2	4	12	1	6		71
Total	118	133	79	16	27	182	18	51	142	6	73		845

TABLE 2B: Employment Status of 1986–1987 New Doctorates in the Mathematical Sciences Females Only

Type of Employer	PURE MATHEMATICS												Total
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other		
Group I	1	2	1						1				5
Group II	1					1		1	2		1		6
Group III	1						1	1	3	1			7
Group IV					2	5							7
Group V													0
Masters	3	5	1			2			4	1			16
Bachelors	4	1	1			2			2	1	2		13
Two-year College													0
Other Academic Departments		1				10		2			3		16
Research Institutes											1		1
Government													0
Business and Industry	1			1	2	11		1	3		4		23
Canada, Academic						2					2		4
Canada, Nonacademic						1							1
Foreign, Academic	1	3	2		2	6	1	1	4	1	1		22
Foreign, Nonacademic	2	1				3							6
Not seeking employment			1						1				2
Not yet employed		2				3	1		1				7
Unknown	1	1		1		3		1	1		1		9
Total	15	16	6	2	6	49	3	7	22	4	15		145

receiving doctorates in the mathematical sciences from U.S. universities has declined consistently, from 73% in 1979–1980 to 49% in 1986–1987. The number of U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities in 1986–1987 is below 400. See Table 4 and accompanying graphs.

Women comprise 20% of the U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities in 1986–1987. Since 1972–1973 this percentage has doubled. It has held fairly constant at or above 20% for the last five years. Table 5 presents the data for the period 1972-1973 through 1986-1987.

The employment matrix, Table 2A, is similar to last year's, with a few exceptions. Only 70 new doctorates were hired by Group I (compared to 88 last year), and only 26 new doctorates were hired by Group IV (compared to 35 last year). Only 110 of the new doctorates report employment in government or business and industry (compared to 127 last year). There is a drastic increase in the number of new doctorates who chose foreign academic employment (142 compared to 89 last year). Thus, 47% of this year's new doctorates found employment in foreign academic institutions (compared to 11% last year).

Employment Status of New Doctorates, 1986–1987. Table 2A shows the employment status, by type of employer and field of degree, of the 845 recipients of doctoral degrees conferred by the mathematical sciences departments in the U.S. and Canada between July 1, 1986, and June 30, 1987. The names of these 845 individuals are listed with their thesis titles in a later section of this Report.

In rows 1 through 5 the numbers represent those who have accepted appointments in U.S. doctorate-granting mathematical sciences departments (Groups I–V). In the next two rows the figures represent those accepting appointments in U.S. mathematical sciences departments granting masters and bachelors as the highest degree. The information was obtained from the departments granting the degrees and from the recipients themselves.

Among the 1986–1987 new doctorates employed in the U.S. (527), 60% (318) took academic positions in university or four-year college mathematical sciences departments, and 21% (110) took employment in government, business, or industry. Each of these is a two percentage point drop from last year, the result of recipients choosing foreign employment.

TABLE 3: Sex, Minority Group, and Citizenship of New Doctorates

July 1, 1986–June 30, 1987

U.S. DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander	7	1	131	3	142	2		27		29	171
Black	6		5		11						11
American Indian, Eskimo, Aleut	1				1						1
Mexican American, Chicano, Puerto Rican	4		20		24	2		4		6	30
None of those above	259	5	148	1	413	67		27		94	507
Unknown	12	1	7	33	53	2		1	3	6	59
Total Number	289	7	311	37	644	73		59	3	135	779

CANADIAN DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander		5	10		15						15
Black			3		3						3
American Indian, Eskimo, Aleut											
Mexican American, Chicano, Puerto Rican								1		1	2
None of those above		18	14		32		5	2		7	39
Unknown	1	5			6		1	1		2	8
Total Number	1	28	27		56		6	4		10	67

Table 2A shows as "not yet employed" about 5% of the 1986–1987 new doctorates, excluding those whose employment status is unknown. The data in Table 2A were obtained in many instances early in the summer of 1987 and do not reflect subsequent hiring; an update of Table 2A is planned for the February 1988 *Notices*. A similar update last year revealed that all but 17 new 1985–1986 doctorates found positions by fall 1986 (see *Notices*, November 1986, page 920, and February 1987, page 253). Eight persons included in Table 2A reported taking part-time employment. This year we present the employment matrix for the 145 women new doctorates (Table 2B).

Sex, Minority Group, and Citizenship of New Doctorates, 1986–1987. Table 3 presents a breakdown according to sex, minority group, and citizenship of these 845 new doctorates. The information reported in this table was obtained from departments granting the degrees and in some cases from the recipients themselves.

Analyses of the 1986–1987 employment matrices (Tables 2A, 2B) indicate that of the 152 new doctorates employed by Group I, II, or III departments, 12% are women. Comparable figures for 1985–1986 and 1984–1985 were 16% and 13% respectively, but were 10% for the previous three years.

Of the 130 new doctorates employed by Groups M and B institutions, 22% are women (compared to 21% last year and 26% two years ago); of the 110 new doctorates employed by government, business and industry, 21% are women (compared to 14% last year and 15% two years ago).

TABLE 4: U.S. Citizen Doctorates

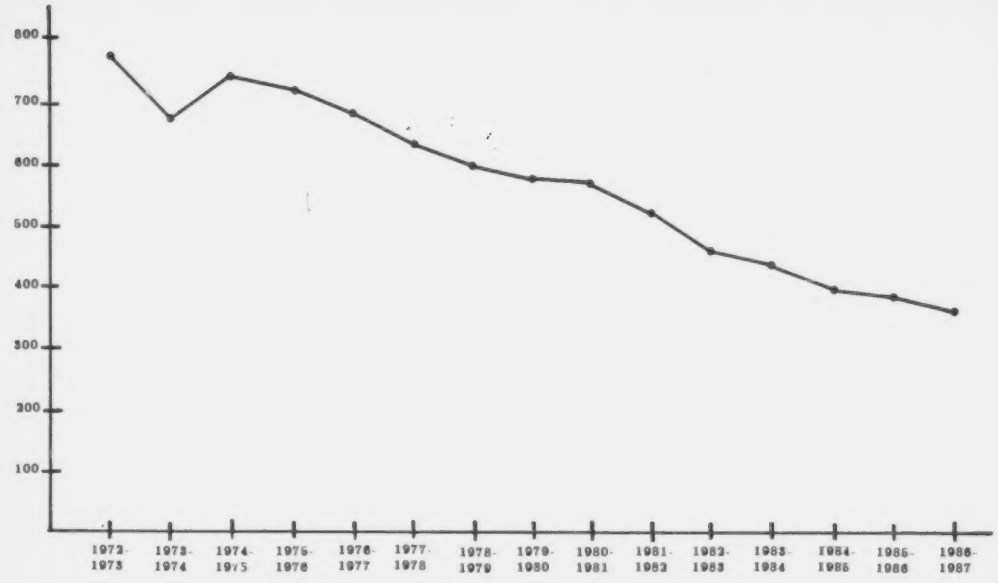
	Adjusted Total of Doctorates given by U.S. universities	Total of Doctorates who are U.S. citizens	%
1972-1973	986	774	78%
1973-1974	938	677	72%
1974-1975	999	741	74%
1975-1976	965	722	75%
1976-1977	901	689	76%
1977-1978	868	634	73%
1978-1979	806	596	74%
1979-1980	791	578	73%
1980-1981	839	567	68%
1981-1982	798	519	65%
1982-1983	744	455	61%
1983-1984	738	433	59%
1984-1985	726	396	55%
1985-1986	755	386	51%
1986-1987	739	362	49%

Citizenship and Sex of U.S. Doctorates, 1972–1987. Again this year, information is presented on the annual number of doctorates granted by U.S. universities to U.S. citizens (Table 4). This number is divided into male and female doctorates (Table 5). These data are presented for the period 1972–1987 using the Annual AMS-MAA Survey Reports on new doctorates published each year in the October or November *Notices*. Thus Tables 4 and 5 are extensions of tables in last year's Report. In Table 4 the first column (headed Adjusted Total of Doctorates given by U.S. Universities) gives the number of doctorates granted between July 1 and June 30 of the indicated years *whose citizenship is known*. Column 2 gives the number who were U.S. citizens and Column 3 the percentage that this represents. In Table 5 the number in Column 2 of Table 4 is further divided into men and women. Note that in both tables *all years prior to* 1982–1983 include doctorates granted by computer science departments.

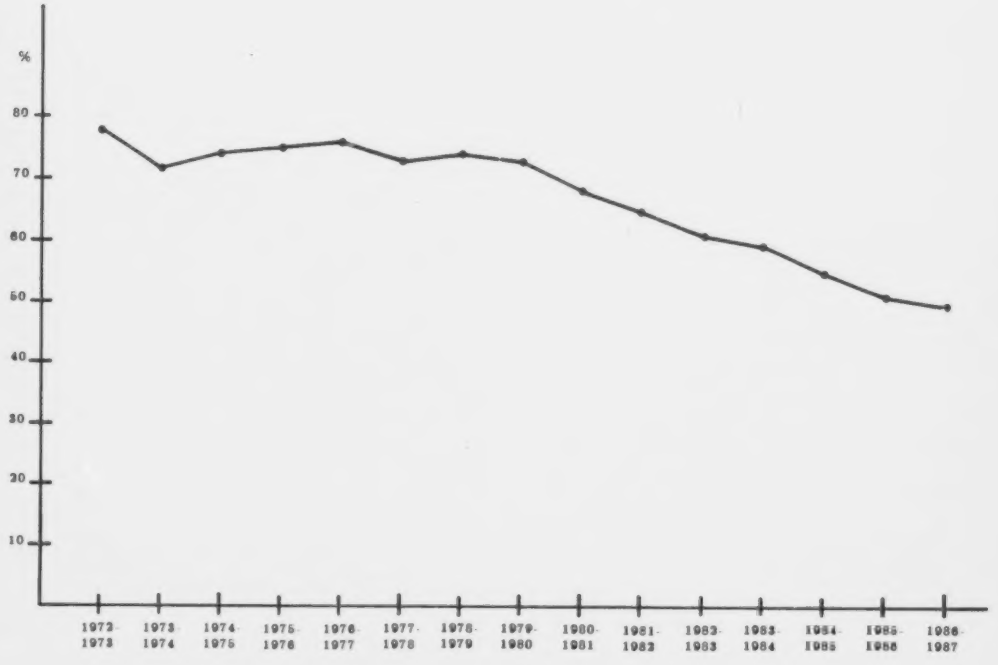
TABLE 5: U.S. Citizen Doctorates, Male and Female

	Doctorates who are U.S. Citizens	Male	Female	% Female
1972-1973	774	696	78	10%
1973-1974	677	618	59	9%
1974-1975	741	658	83	11%
1975-1976	722	636	86	12%
1976-1977	689	602	87	13%
1977-1978	634	545	89	14%
1978-1979	596	503	93	16%
1979-1980	578	491	87	15%
1980-1981	567	465	102	18%
1981-1982	519	431	88	17%
1982-1983	455	366	89	20%
1983-1984	433	346	87	20%
1984-1985	396	315	81	20%
1985-1986	386	304	82	21%
1986-1987	362	289	73	20%

We express again our concern at the persistent plummeting in both the absolute number and the relative percentage of U.S. citizens among the new Ph.D.'s in the mathematical sciences. In last year's report (November 1986 *Notices*, page 922) we wrote: "There are several important and timely questions and issues that need to be raised and addressed on this and similar trends in the mathematical and scientific disciplines. For example, how will a moderate to severe shortage of well-trained Ph.D.'s in the mathematical sciences impact on American business, industry, and government? Will American institutions—educational and otherwise—enter the 21st century with a disproportionate part of their population of mathematical scientists at, near, or past retirement age and find an inadequate number of qualified replacements"? Fortunately, there is evidence that some measures are being discussed and implemented which are intended to preclude the shortage of trained personnel in the mathematical sciences (see (1), (2), (3) and (11) in the bibliography below). It remains to be seen, however, if these and similar measures are successful.



Graph for Table 4: U.S. Citizen Doctorates
Total of Doctorates Who Are U.S. Citizens



Graph for Table 4: U.S. Citizen Doctorates
Total of Doctorates by Percent

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NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

1987 ANNUAL AMS-MAA SURVEY

(Second Report)

Vital Statistics in the Mathematical Sciences:
Enrollments, Faculty Size and Mobility, Majors and Graduate Students,
with an Update on Employment of New Doctorates
Fall 1987

Edward A. Connors

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HIGHLIGHTS

1. *Our final (spring) count of new doctorates in the mathematical sciences shows fewer than 400 U.S. citizens among the 874 doctoral recipients in the U.S. and Canada — this is the lowest number in two decades.*
2. *Group M and B departments (departments granting a master's or bachelor's degree as the highest degree) report a larger than usual retirement/death rate; the number of doctoral faculty retiring or dying last year is estimated as twice that of the previous year.*
3. *Undergraduate enrollments in mathematics courses are down for the third consecutive year. Junior-senior mathematics totals are down more than 4%. Remedial mathematics and "pre-calculus" continue to consume a considerable chunk of collegiate mathematics education.*
4. *Women comprise 17% of the new doctorate population. Twenty percent of the women new doctorates report taking employment in the doctorate-granting institutions, but they represent only 12% of the total new doctorates hired by these institutions.*
5. *For the third straight year approximately 20% of the new doctorates report foreign academic or nonacademic employment ("foreign" excludes Canadian).*
6. *For the fifth consecutive year nearly half of the new doctorates are in applied fields and more than a fifth are in statistics.*
7. *In most U.S. doctorate-granting departments, U.S. citizens comprise more than half of the first-year and total graduate school population, but rarely more than 60%.*

I. INTRODUCTION

We report on several items of general and specific interest to the mathematical community, based on our analysis of the data compiled in the 1987 Annual AMS-MAA Survey. We begin with an update on the size and employment status of the 1986–1987 class of new doctorates, and then we direct our attention to the information provided by the departmental responses to the surveys on Faculty Mobility and Enrollments and Departmental Size. The numbers we provide on faculty size, mobility and status (Tables 2A, 2B, and 2C), course enrollments (Table 5), majors (Table 6), and graduate students (Table 7) are estimates based on extrapolation of data reported (for a detailed explanation of our extrapolation methodology see the Second Report, 1986 Survey, February 1987 *Notices*, page 255). However, the Mobility and Enrollments Surveys requested data for fall 1986 and fall 1987, so we have data for consecutive years from the same sample—this is the basis of the percentage increase/decrease calculations which, for example, we made for fall 1986 versus fall 1987 Enrollments, Majors, and Graduate Students (Tables 5, 6, and 7).

A description of the classification of departments, together with a list of institutions in Groups I and II, can be found in the Appendix of this report.

A first report of the 1987 Survey appeared in the November 1987 *Notices*, pages 1072–1101, with corrections in the January 1988 *Notices*, pages 21–23. It included a report of the survey of faculty salaries, tenure, and women, a first report of the survey of new 1986–1987 doctorates, and a list of the names and thesis titles of the 1986–1987 doctorates. This second report includes an update of the fall 1987 employment status of new doctorates, an analysis of faculty mobility, a report on fall 1987 enrollments and class sizes, and a supplementary list of 1986–1987 doctorates.

The 1987 Annual AMS-MAA Survey represents the thirty-first in an annual series begun in 1957 by the Society. The 1987 Survey, the first to be jointly sponsored by the American Mathematical Society and the Mathematical Association of America, is under the direction of the AMS-MAA Committee on Employment and Educational Policy (CEEP), whose members in 1987 were Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Philip C. Curtis, Jr., David J. Lutzer, Donald C. Rung, and Audrey A. Terras. The questionnaires were devised by CEEP's Data Subcommittee whose members in 1987 were Lida K. Barrett, Edward A. Connors (chair), Lincoln K. Durst (consultant), James F. Hurley, Charlotte Lin, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung. Comments or suggestions regarding this Survey may be directed to the subcommittee.

II. UPDATE ON THE 1986–1987 NEW DOCTORATES

In the First Report of this Survey (November 1987 issue of *Notices*, pages 1081–1086) we reported 845 new doctorates in the mathematical sciences (779 from U.S. universities and 66 from Canadian universities) — this is the fall count. There were an additional 29 new doctorates, all from U.S. universities with a Group I, II, III, IV or Va classification. We now update tables from the First Report (New Doctorates, Fall and Spring Counts, and New Doctorates awarded by Groups I–Va, VI, see November 1987 *Notices*, page 1081) with this new information to produce the 1986–1987 spring counts (874 new doctorates, with 808 awarded by U.S. universities). We do not, however, include the 29 additional new doctorates in our updated employment matrices (Tables 1A, 1B and 1C).

Useable Responses

	Groups							
	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	35	38	56	41	13	13	119	370
Faculty Mobility	30	32	46	39	11	9	110	345

*There are 4 parts to the Enrollments and Departmental Size Form (Enrollments, Majors, Departmental Size, and Graduate Students). The number given is the number of returns with a useable response on the departmental size.

Useable Responses (Percentage of Surveyed Departments)

	Groups							
	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	90	88	71	60	42	46	45	39
Faculty Mobility	77	74	58	57	35	32	42	36

*As above.

New Doctorates Fall and Spring Counts

	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987
Fall	792	789	769	801	845
Spring	840	827	807	827	874

New Doctorates U.S. Institutions, Spring Count

1982-1983	1983-1984	1984-1985	1985-1986	1986-1987
796	775	765	782	808

New Doctorates Awarded by Groups I–Va, VI, Spring Count

1982-1983	1983-1984	1984-1985	1985-1986	1986-1987
767	735	755	743	809

A significant portion of the 845 new doctorates, 17%, reported foreign academic employment (compared to 11% and 12%, respectively, in the last two years). The percentage of the new doctorates reporting foreign academic or nonacademic employment is 19% (compared to 19% and 20%, respectively, in the last two years).

Women comprise 17% of the present new doctorate population, and 20% of the 145 found employment in the doctorate-granting departments I–VI. However, women represent only 12% of the total of new doctorates hired by the research departments. In contrast, women comprise 26% of the new doctorates hired by Group M, and 19% of the new doctorates hired by Group B. Business and industry hired 104 of the new doctorates (60 males, 24 females), but none of our female respondents reports government employment.

The research fields of the new doctorates continue to have an applied flavor (see Table 1C). For the last five years half, or nearly half, of the new doctorates specialized in statistics, applied mathematics, operations research, or computer science. In fact, in each of the years in question between one-fifth and one-fourth of the degrees were in statistics.

There are a few noticeable differences from last year in the hiring of new doctorates by academic institutions: Group I hired 12% fewer, Group II hired 12% more, and Group III hired exactly the same number. In departments of statistics and biostatistics (Group IV) new doctorate hiring was down considerably (by 22%), whereas Canadian academic hiring was up considerably (by 38%). Group M departments increased their new doctorate hiring by 11% over last year's total, and Group B increased theirs by 9%. Government hiring of new doctorates was 19, down from the 17 reported last year, and the number hired by business/industry fell to 104 from 109. Not surprising is that most, but by no means all, of the new doctorates hired by government, business and industry specialized in statistics or applied mathematics.

Finally, we note that the names of the new doctorates and their thesis titles are published in the *Notices* (November 1987 issue and a supplemental list in the Appendix of this report).

Table 1A: Employment Status of 1986–1987 New Doctorates in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS											
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	23	17	19	2	1	1	0	0	10	0	5	78
Group II	7	7	5	0	3	2	1	2	8	0	3	38
Group III	7	12	1	1	1	7	3	2	12	1	0	47
Group IV	0	0	0	0	3	23	0	1	0	0	1	28
Group V	0	0	0	0	0	0	0	0	9	0	2	11
Masters	13	13	12	0	3	12	1	2	11	1	1	69
Bachelors	16	12	10	0	3	11	0	3	12	2	3	72
Two-year College or High School	4	1	1	1	0	0	0	0	1	0	0	8
Other Academic Departments	2	4	0	2	1	32	5	12	7	0	12	77
Research Institutes	3	5	5	0	0	3	0	3	7	0	2	28
Government	1	0	0	0	0	7	1	1	5	0	4	19
Business and Industry	6	9	2	4	7	31	1	12	15	0	17	104
Canada, Academic	4	7	2	0	1	8	1	1	3	0	6	33
Canada, Nonacademic	0	0	0	0	0	3	0	0	1	0	0	4
Foreign, Academic	22	29	14	3	4	25	2	9	27	1	9	145
Foreign, Nonacademic	3	4	0	0	0	5	1	2	1	0	3	19
Not seeking employment	1	2	2	0	0	0	0	0	2	0	1	8
Not yet employed	2	5	1	0	0	8	0	0	5	0	1	22
Unknown	4	6	5	3	0	4	2	1	6	1	3	35
Total	118	133	79	16	27	182	18	51	142	6	73	845

Table 1B: Employment Status of 1986-1987 New Doctorates in the Mathematical Sciences Females Only

Type of Employer	PURE MATHEMATICS											
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	1	2	1	0	0	0	0	0	1	0	0	5
Group II	1	0	0	0	0	1	0	1	2	0	1	6
Group III	1	0	0	0	0	0	1	1	3	1	0	7
Group IV	0	0	0	0	2	5	0	0	0	0	0	7
Group V	0	0	0	0	0	0	0	0	0	0	0	0
Masters	3	5	1	0	0	4	0	0	4	1	0	18
Bachelors	4	2	1	0	0	2	0	0	2	1	2	14
Two-year College or High School	0	0	0	0	0	0	0	0	0	0	0	0
Other Academic Departments	0	1	0	0	0	10	1	3	0	0	4	19
Research Institutes	0	0	0	0	0	0	0	0	0	0	1	1
Government	0	0	0	0	0	0	0	0	0	0	0	0
Business and Industry	1	0	0	1	2	12	0	1	3	0	4	24
Canada, Academic	0	0	0	0	0	2	0	0	0	0	2	4
Canada, Nonacademic	0	0	0	0	0	1	0	0	0	0	0	1
Foreign, Academic	1	3	2	0	2	7	1	1	4	1	1	23
Foreign, Nonacademic	2	1	0	0	0	3	0	0	0	0	0	6
Not seeking employment	0	0	1	0	0	0	0	0	2	0	0	3
Not yet employed	0	1	0	0	0	1	0	0	1	0	0	3
Unknown	1	1	0	1	0	1	0	0	0	0	0	4
Total	15	16	6	2	6	49	3	7	22	4	15	145

Table 1C: Fields of New Doctorates

	Year Surveyed				
	1982–1983	1983–1984	1984–1985	1985–1986	1986–1987
Number (Fall Count)	792	789	769	801	845
Specialty:					
Applied Math	103 (13%)	110 (14%)	115 (15%)	149 (19%)	142 (17%)
Statistics	188 (24%)	173 (22%)	189 (25%)	171 (21%)	182 (22%)
Operations Research	63 (8%)	66 (8%)	41 (5%)	62 (8%)	51 (6%)
Computer Science	18 (2%)	20 (3%)	15 (2%)	16 (2%)	18 (2%)
Total	372 (47%)	369 (47%)	360 (47%)	398 (50%)	393 (47%)

III. FACULTY CHARACTERISTICS: SIZE, MOBILITY, AND STATUS

We present some of the vital features of our contemporary mathematical sciences faculty in Tables 2A, 2B, 2C, 4, and 10. Estimates of current size and proportions of doctoral/nondoctoral, tenured/nontenured, and full/part-time faculty are provided, although we do not publish all the information available to us—for example, in analyzing faculty flow in Groups I-III and IV (see Tables 2A and 2B), we concentrate on full-time doctoral faculty with a refinement into tenured and nontenured, whereas the analogous analysis in Groups M and B is done for full-time faculty with a breakdown into doctoral and nondoctoral faculty.

We comment on three specific features of the future of our mathematics faculty, all related to the supply and demand for mathematical scientists. As reported in the First Report of the 1987 Survey (see November 1987 issue of *Notices*), fewer than 400 U.S. citizens earned a doctorate in the mathematical sciences during 1986–1987. Current information available to us does not indicate evidence of change in this pattern of Ph.D. productivity (see for example the data on the decline in the number of mathematics majors reported in Table 6, the size of the U.S. contingent in the graduate schools as reported in Table 8, and the pessimistic predictions inherent in reference [12]). The current mathematics faculty, however, becomes more gray as evidenced by a nearly 2% retirement/death rate of Group M and B faculty. We estimate that 1.4% of the 20,000 full-time mathematical science faculty in the U.S. retired (or died) last year. Moreover, in Groups M and B we estimate that 132 doctoral faculty retired or died last year compared to 67 the year before. Among all full-time faculty, Groups M and B had 223 retirements or deaths last year, compared to 169 the year before.

Our new data indicate that 47% of the new full-time faculty positions filled by nondoctoral faculty in Groups M and B were intended for doctorate holders—this projects to 250 nondoctorate faculty holding positions for which a doctorate-holding faculty was preferred. It is becoming increasingly more likely that vacant full-time faculty positions in Groups M and B will be filled by nondoctorate faculty. It is already the case that a considerable portion of the teaching responsibilities in Groups M and B is assumed by part-time faculty (see Table 10 and reference [8]).

Table 2A: Faculty Flow
1986–1987 to 1987–1988
Full-Time Doctorate-Holding
Faculty in 155 Doctorate-Granting
Mathematics Departments in the U.S.
(Groups I, II, III)

Sources of New Faculty

From	Nontenured	Tenured
Graduate School	143	1
Faculty position in another U.S. or Canadian college or univ. dept.	121	46
Business, industry, or government in the U.S. or Canada	7	3
Outside the U.S. or Canada	32	6
Other sources (e.g., part-time in same dept.)	16	6
Total in	319	62

Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	79	50
Other four-year college or university position	40	10
Two year college	--	--
Other	13	--
Total Academic	132	60

Table 2A: Faculty Leaving (continued)

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	15	10
Other	1	4
Total Nonacademic	16	14
To OTHER:		
Currently seeking professional employment	9	
Obtained a position outside the U.S. or Canada	32	4
Either retired (and do not seek employment) or have died		57
Returned to graduate or professional school	1	
Status unknown/other	15	4
Total Other	57	65
Total Out	205	139

Received doctorate and not moving	10 (tenure status unknown)
Received tenure and not moving	129
Estimated size of full-time faculty, Fall 1987 Groups I–III	
Doctorate, Tenure status unknown	10
Doctorate, Nontenured	1,395 (+114 from Fall 1986)
Doctorate, Tenured	4,294 (+52 from Fall 1986)
Total Doctorate Faculty	5,699 (+164 from Fall 1986)*
Nondoctorate Faculty	385 (-11 from Fall 1986)
Total full-time Faculty	6,084 (+153 from Fall 1986)

*There is a typographical error in last year's total (5,533 should be 5,535)

Table 2B: Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	18	3
Other four-year college or university position	8	
Two year college		
Other	1	1
Total Academic	27	4

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	3	1
Other		1
Total Nonacademic	3	2
To OTHER:		
Currently seeking professional employment		
Obtained a position outside the U.S. or Canada	8	
Either retired (and do not seek employment) or have died		8
Returned to graduate or professional school	1	
Status unknown/other	1	
Total Other	16	12
Total Out	46	18

Received doctorate and not moving	1
Received tenure and not moving	17
Estimated size of full-time faculty, Fall 1987 Group IV	
Doctorate, Tenure status unknown	1
Doctorate, Nontenured	232 (-8 from Fall 1986)
Doctorate, Tenured	531 (+3 from Fall 1986)
Total Doctorate Faculty	764
Nondoctorate Faculty	22 (+3 from Fall 1986)
Total full-time Faculty	786 (-2 from Fall 1986)

Table 2B: Faculty Flow 1986–1987 to 1987–1988

Full-Time Doctorate-Holding Faculty in Group IV

Sources of New Faculty

From	Nontenured	Tenured
Graduate School	27	
Faculty position in another U.S. or Canadian college or univ. dept.	17	4
Business, industry, or government in the U.S. or Canada	3	
Outside the U.S. or Canada	5	
Other sources (e.g., part-time in same dept.)	3	
Total in	55	4

Table 2C: Faculty Flow
1986–1987 to 1987–1988
Full-Time Mathematical Sciences
Faculty in Groups M and B

Sources of New Faculty

From	Doctorate	Nondoctorate
Graduate School	199	215
Faculty position in another U.S. or Canadian college or univ. dept.	395	110
Business, industry, or government in the U.S. or Canada	83	35
Outside the U.S. or Canada	30	3
Other sources (e.g., part-time in same dept.)	30	169
Total in	737	532

Faculty Leaving

	Doctorate	Nondoctorate
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	40	32
Other four-year college or university position	178	89
Two year college	3	32
Other	27	5
Total Academic	148	158

	Doctorate	Nondoctorate
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	48	54
Other	19	13
Total Nonacademic	67	67
To OTHER:		
Currently seeking professional employment	19	22
Obtained a position outside the U.S. or Canada	5	
Either retired (and do not seek employment) or have died	132	91
Returned to graduate or professional school	11	75
Status unknown/other	35	35
Total Other	202	223
Total Out	417	448

Received doctorate and not moving	43
Received tenure and not moving	331
Doctorate	296
Nondoctorate	35
Estimated size of full-time faculty, Fall 1987 Groups M and B	
Doctorate-Holding	9,658 (+363 from Fall 1986)
Nondoctorate Faculty	4,070 (+41 from Fall 1986)
Total full-time Faculty	13,728 (+404 from Fall 1986)

IV. UNDERGRADUATE ENROLLMENTS, MAJORS AND CLASS SIZE

We use a different classification of undergraduate courses in this year's Survey, so we advise caution in comparisons with earlier Surveys. Again, we emphasize that our survey forms requested data for fall 1986 and fall 1987, so our calculations of percentage changes from 1986 to 1987 are based on real data from the same sample.

We again report a decrease in undergraduate enrollments, as we have for the last two enrollment surveys (Table 5). A considerable chunk of our undergraduate teaching in the mathematical sciences is concentrated in remedial and "precalculus" mathematics. We urge the reader to compare our data on this part of the Survey to that of their own institution and to report the findings and comments to us. We note the declines in first-year calculus and "other undergraduate mathematics courses (predominantly mathematics majors)" with particular concern, since these courses are the present site of many of our future mathematical scientists. Our concern in the decline in the enrollments in calculus and upper division mathematics courses is magnified by the large decline in junior-senior level mathematics majors. We note, with emphasis, the 5% decline in majors reported by the M and B departments—a large part of the aquifer of U.S. mathematics.

V. GRADUATE ENROLLMENTS AND CITIZENSHIP

Graduate student numbers, first-year and total, reflect a robust increase over last year (Table 7), and graduate enrollments do likewise (Table 5). However, the percentages of U.S. citizens among the first-year or entire graduate population barely exceed 50%. But the relative size of the U.S. citizens in the graduate population is not the most important consideration—one should ask, however, why are there not more U.S. citizens among the doctoral candidates and recipients? Where in our educational system has the pump plugged and the pipeline leaked?

Table 3: New Mathematical Sciences Doctorates Taking Nonacademic Positions in U.S.

	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987
In govt.	37	38	22	24	23	14	27	19
In bus./industry	165	159	141	105	110	108	109	104
Total	202	197	163	129	133	122	136	123
Total new doctorates employed in U.S.	691	732	659	583	597	557	577	579
% in govt./bus./ind.	29%	27%	25%	22%	22%	22%	24%	21%

Table 4: Estimated Net Outflow of Doctorate-Holding Faculty Members to Nonacademic Employment

	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987
Net outflow	168	116	94	46	125	22	55	23

Table 5: Total Course Enrollments for Fall 1987 (in Thousands)
(Percent increase from fall 1986 in parentheses)*

Type of Course	Groups			
	I,II,III	IV	VI	M,B
Remedial mathematics (arithmetic, high-school algebra, geometry)	68 (-2%)		2 (+5%)	210 (+2%)
Traditional pre-calculus	123 (0%)		9 (-1%)	222 (-2%)
First-year calculus courses	203 (-1%)		35 (+2%)	234 (-3%)
Undergraduate courses in statistics	20 (-2%)	47 (+3%)	16 (+16%)	118 (-1%)
Undergraduate courses in computer science	10 (-2%)		6 (-9%)	164 (-5%)
Other undergraduate math courses (predominately math majors)	68 (-6%)		24 (+17%)	128 (-6%)
Other undergraduate math courses (predominately nonmath majors)	127 (+3%)		11 (-9%)	251 (+5%)
Total Undergrad	619 (-1%)	51 (+3%)		326 (-1%)
All graduate courses	29 (+5%)	13 (+3%)	1 (+4%)	20 (+3%)
All courses	648 (-1%)	64 (+3%)	104 (+5%)	1346 (-1%)

*This percentage is obtained from the raw data as reported for the two years on this 1987 Annual Survey. It is not based on last year's estimates.

Table 6: Majors
(Percent increase over fall 1986 in parentheses)*

Fall 1987	Groups			
	I,II,III	IV	VI	M,B
Total junior-senior majors	18,690 (-4%)	1,098 (-5%)	6,507 (-2%)	58,718 (-5%)

*See footnote for Table 5.

Table 7: Graduate Students
(Percent increase over fall 1986 in parentheses)

Fall 1987	Groups			
	I,II,III	IV	VI	M,B
First Year	2,879 (+4%)	676 (+9%)	245 (+12%)	1,456 (+18%)
All	9,177 (+5%)	2,039 (+3%)	914 (+13%)	3,420 (+9%)

Table 8: Citizenship of Graduate Students
(Percentage of U.S. citizens of graduate students whose citizenship is reported as known)

	Fall 1986		Fall 1987	
Group	First Year	All Years	First Year	All Years
I	53	53	54	52
II	55	54	58	53
III	59	58	59	58
I,II,III	55	55	57	54
IV	57	52	45	51
M	68	70	70	71

Table 9: Average Class Size Fall 1987*

Type of Course	Groups						
	I	II	III	IV	VI	M	B
Remedial mathematics (arithmetic, high-school algebra, geometry)	34	36	41		70	41	28
Traditional pre-calculus	36	38	41		69	38	30
First-year calculus courses	38	44	40		89	33	25
Undergraduate courses in statistics	31	43	71**	40	51	33	27
Undergraduate courses in computer science	42	29	24		50	22	19
Other undergraduate math courses (predominately math majors)	27	25	25		49	21	15
Other undergraduate math courses (predominately nonmath majors)	40	36	40		46	34	28
All graduate courses	11	11	10	16	5	9	15
All courses	31	34	35	30	51	30	24

*We do not provide the previous year's average as also reported in this year's survey, because there are no significant differences.

**We attribute this increase over last year's reported average of 37 to our different course groupings. The average for Fall 1986 using this same classification of courses is 64. Apparently some statistics courses were reported in the below calculus classification no longer used.

Table 10: Ratio of Full-time to Part-time Faculty (Excluding T.A.'s)* Fall 1987

	Groups							
	I	II	III	IV	V	VI	M	B
All	13:1	6:1	4:1	5:1	11:1	9:1	3:1	2:1
Doctoral	30:1	23:1	15:1	6:1	13:1	15:1	12:1	9:1

*Based on raw data from the departmental size part of the Enrollments and Departmental Size Survey (see the useable response tables listed earlier).

Appendix

ACKNOWLEDGEMENT

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the mathematical scene vital to the entire mathematical community. Yearly, collegiate departments in the United States, and the doctoral-granting departments in Canada, are provided the opportunity to respond to this survey (Survey of New Doctorates for departments with a doctoral program in the mathematical sciences, Enrollments and Departmental Size, and Faculty Mobility for all departments). The quantity and quality of the responses directly determine the quality of the information in these reports. Without the dedicated cooperation of the secretarial and administrative support staff in the mathematical science departments we would not be able to conduct a survey, nor be confident in our analysis of its results. We are, unfortunately, unable to thank all the departmental assistants for their cooperation, but it is nonetheless appreciated. However, we are able to thank the administrative support staff of the AMS, especially Marcia Almeida, Monica Foulkes, James W. Maxwell, and James A. Voytuk. Their efforts are acknowledged and appreciated.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0–5.0 range.

Group II is composed of 43 departments with scores in the 2.0–2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257–267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392–393.

CLASSIFICATION OF DEPARTMENTS

Group I

Brandeis University
Brown University
California Institute of Technology
California, University of (Berkeley)
California, University of (Los Angeles)
California, University of (San Diego)
Carnegie-Mellon University
Chicago, University of
Columbia University
Cornell University
CUNY Graduate School
Harvard University
Illinois, University of
Illinois, University of (Chicago)
Indiana University
Johns Hopkins University
Maryland, University of
Massachusetts Institute of Technology
Michigan, University of
Minnesota, University of
New York University
North Carolina, University of
Northwestern University
Ohio State University
Pennsylvania State University
Pennsylvania, University of
Princeton University
Purdue University
Rice University
Rutgers University
Stanford University
SUNY at Stony Brook
Texas, University of (Austin)
Utah, University of
Virginia, University of
Washington University
Washington, University of
Wisconsin, University of
Yale University

Group II

Arizona, University of
California, University of (Davis)
California, University of (Riverside)
California, University of (Santa Barbara)
Case Western Reserve University
Claremont Graduate School
Colorado, University of
Connecticut, University of
Dartmouth College

Group II (continued)

Delaware, University of
Duke University
Florida State University
Florida, University of
Georgia Institute of Technology
Georgia, University of
Iowa State University
Iowa, University of
Kansas, University of
Kentucky, University of
Louisiana State University
Massachusetts, University of (Amherst)
Michigan State University
New Mexico, University of
North Carolina State University
Northeastern University
Notre Dame, University of
Oklahoma, University of
Oregon State University
Oregon, University of
Pittsburgh, University of
Polytechnic Institute of New York
Rensselaer Polytechnic Institute
Rochester, University of
Southern California, University of
SUNY at Albany
SUNY at Buffalo
Syracuse University
Temple University
Tennessee, University of
Tulane University
Vanderbilt University
Virginia Polytechnic Institute & State University
Wayne State University

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